

CLAIMS:

- 1 1. A signal distribution system for distributing wireless communications network
2 signals, the system comprising:
3 a plurality of rf transmitters for transmitting rf signals to serve communications
4 devices in a plurality of network cells or sectors; and
5 characterised in that the system further comprises:
6 a multiplexer, coupled to the rf transmitters, for multiplexing output signals from
7 the transmitters and outputting a multiplexed transmitter signal;
8 a signal transporter, coupled to the multiplexer, for transporting the multiplexed
9 transmitter signals to each of the network cells or sectors served by the transmitters; and
10 a multiplexed signal receiver at each served cell or sector, coupled to the signal
11 transporter, for selecting and receiving a transmitter signal from an rf transmitter
12 serving the cell or sector from the multiplexed transmitter signal.
- 1 2. A signal distribution system as claimed in claim 1, further comprising a transmit
2 antenna at each served cell or sector, coupled to an output of a respective multiplexed
3 signal receiver, for transmitting a signal from the rf transmitter serving the cell or sector
4 to a communications device within the cell or sector.
- 1 3. A signal distribution system as claimed in claim 2, further comprising at least
2 one signal combiner having inputs coupled to at least two of the rf transmitters and an
3 output coupled to the multiplexer, to combine the outputs of the rf transmitters and
4 output a combined signal for multiplexing.
- 1 4. A signal distribution system as claimed in claim 3, wherein each transmitter is
2 connected to a common digital interface to a digital data transmission network.
- 1 5. A signal distribution system as claimed in claim 1, further comprising:

2 a plurality of rf receivers, each associated with a said rf transmitter, for receiving
3 rf signals from devices in the plurality of network cells or sectors;

4 a cell signal transmitter at each cell or sector, coupled to the signal transporter,
5 for receiving a signal from a communications device in the cell or sector and for
6 outputting a cell or sector signal onto the signal transporter to make up at least part of a
7 multiplexed cell or sector signal; and

8 a demultiplexer, coupled to the signal transporter, for demultiplexing the
9 multiplexed cell or sector signal and for outputting a plurality of demultiplexed cell or
10 sector signals corresponding to the plurality of rf receivers.

1 6. A signal distribution system as claimed in claim 5, further comprising a receiver
2 antenna at each said cell or sector, coupled to the respective cell or sector signal
3 transmitter of the cell or sector.

1 7. A signal distribution system as claimed in claim 5 or 6, further comprising at
2 least one signal splitter having an input coupled to the demultiplexer and outputs
3 coupled to at least two of the rf receivers, to provide at least one said demultiplexed cell
4 or sector signal to two or more of the rf receivers.

1 8. A signal distribution system as claimed in claim 7, comprising a plurality of rf
2 transceivers, each comprising a said rf transmitter and rf receiver, each transceiver
3 forming part of either a Base Transceiver Station (BTS) of a GSM network or a Node B
4 of an IMT-2000 network.

1 9. A signal distribution system as claimed in claim 5, wherein the signal transporter
2 comprises a fibre optic cable, the multiplexed transmitter signal comprises an optical
3 signal and the multiplexed cell signal comprises an optical signal.

1 10. A signal distribution system as claimed in claim 9, wherein the fibre optic cable
2 comprises a pair of optical fibres, a first fibre for transporting the multiplexed

3 transmitter signal and a second fibre for transporting the multiplexed cell or sector
4 signal.

1 11. A signal distribution system as claimed in claim 9, wherein the fibre optic cable
2 forms part of a cable TV distribution system.

1 12. A signal reception system for receiving wireless communications network
2 signals, the system comprising:

3 at least one rf receiver for receiving rf signals from communications devices in a
4 corresponding plurality of network cells or sectors served by the receiver; and

5 characterised in that the system further comprises:

6 a signal transporter for transporting signals from each served cell or sector to a
7 demultiplexer;

8 a cell or sector signal transmitter at each cell or sector, coupled to the signal
9 transporter, for receiving a signal from a communications device in the cell or sector
10 and for transmitting a cell or sector signal onto the signal transporter to make up at least
11 part of a multiplexed cell or sector signal on the signal transporter; and

12 a demultiplexer, coupled to the signal transporter and to the rf receiver, for
13 demultiplexing the multiplexed cell or sector signal on the signal transporter and for
14 outputting a plurality of demultiplexed cell or sector signals to the receiver.

1 13. A signal reception system as claimed in claim 12, further comprising a receive
2 antenna at each said cell or sector, coupled to the respective cell or sector signal
3 transmitter of the cell or sector.

1 14. A signal reception system as claimed in claim 13, comprising a plurality of said
2 rf receivers for receiving signals from the plurality of network cells or sectors, and
3 wherein the demultiplexer outputs the plurality of demultiplexed signals to the plurality
4 of receivers.

1 15. A signal reception system as claimed in claim 14, further comprising at least one
2 signal splitter having an input coupled to the demultiplexer and outputs coupled to at
3 least two of the rf receivers, to provide at least one said demultiplexed cell or sector
4 signal to two or more of the rf receivers.

1 16. A signal reception system as claimed in claim 15, wherein each rf receiver is
2 connected to a common digital interface to a digital data transmission network.

1 17. A signal reception system as claimed in claim 16, wherein the signal transporter
2 comprises a fibre optic cable, and wherein the multiplexed cell or sector signal
3 comprises an optical signal.

1 18. A signal reception system as claimed in claim 17, wherein the fibre optic cable
2 forms part of a cable TV distribution system.

1 19. A signal distribution or reception system as claimed in claim 9 or 17, wherein
2 the fibre optic cable includes a cable loop; the system further comprising a monitor to
3 monitor integrity of signal transmission on the cable loop and a switch responsive to the
4 monitor to reverse a direction of signal transmission on the cable loop in response to the
5 monitor signalling that the integrity of signal transmission is or has been adversely
6 affected.

1 20. A signal distribution system as claimed in claim 19, wherein a said monitor is
2 located at a cell and the switch is located at a point on the cable loop remote from the
3 monitor; the system further comprising a monitoring signal transmitter for transmitting
4 a monitoring signal from the monitor to the switch.

1 21. A signal distribution system as claimed in claim 1 or 12, wherein the plurality of
2 served network cells or sectors comprises cells or sectors of a single mobile
3 communications network operator.

1 22. A signal distribution system as claimed in claim 1 or 12, wherein the plurality of
2 served network cells or sectors comprises cells or sectors of a plurality of different
3 mobile communications network operators.

1 23. A system for distributing signals from an rf transmitter to a plurality of antennas
2 for transmitting to a plurality of coverage regions, the system comprising:

3 an rf-to-optical converter for converting an rf input signal from the transmitter
4 into an optical output signal;

5 a fibre optic cable, coupled to the rf-to-optical converter, for transporting the
6 optical signal; and

7 a plurality of optical-to-rf converters, each coupled to the fibre optic cable, for
8 providing an rf output signal corresponding to the rf signal from the transmitter to the
9 plurality of antennas.

1 24. A system as claimed in claim 23, wherein the fibre optical cable comprises a
2 loop and wherein the optical-to-rf converters are coupled to the fibre optic cable at
3 points within the loop.

1 25. A system as claimed in claim 24, for distributing signals of a cellular
2 communications network, wherein the plurality of antennas serve a plurality of cells or
3 sectors of the network and wherein the transmitter provides a common rf transmit signal
4 for all the said cells or sectors.

1 26. A method of distributing signals for a communications network, the
2 communications network having a plurality of cells or sectors each served by a
3 transmitter, the method comprising:

4 multiplexing output signals from the transmitters to provide a composite signal
5 comprising transmissions for each of the plurality of cells or sectors;

6 distributing the composite signal to each of the cells or sectors; and

7 selecting, at a said cell or sector, the transmission for the cell or sector from the
8 composite signal.

1 27. A method of distributing signals as claimed in claim 26, further comprising:

2 monitoring a signal distribution path; and

switching to an alternate signal distribution path when the monitoring indicates failure or partial failure of the signal distribution path.

1 28. A method as claimed in claim 27, further comprising using a cable TV network
2 to distribute the said composite signal.

1 29. A method of receiving signals for a communications network, the
2 communications network having a plurality of cells or sectors each served by a receiver,
3 the method comprising:

4 receiving signals from communications devices in the plurality of cells or
5 sectors;

6 forming a multiplexed signal comprising the signals received in the cells or
7 sectors;

8 transmitting the multiplexed signal to a demultiplexer;

9 demultiplexing the received signals using the demultiplexer; and

10 providing the or each receiver with a received signal from each said cell or
11 sector.

1 30. A method of receiving signals as claimed in claim 29, further comprising

2 monitoring a signal transmission path; and

3 switching to an alternate signal transmission path when the monitoring indicates
4 failure or partial failure of the signal transmission path.

1 31. A method as claimed in claim 30, further comprising using a cable TV network
2 to transmit the said multiplexed signal.

1 32. A method of distributing signals as claimed in claim 26 or a method of receiving
2 signals as claimed in claim 29, wherein the distributed and/or received signals comprise
3 signals for two or more communications networks having different operators.

1 33. A method of communicating signals for a communications network, the
2 communications network having a plurality of cells or sectors each served by a
3 transmitter and receiver, the method comprising:

4 multiplexing output signals from the transmitters to provide a composite signal
5 comprising transmissions for each of the plurality of cells or sectors;

6 distributing the composite signal to each of the cells or sectors; and

7 selecting, at a said cell or sector, the transmission for the cell or sector from the
8 composite signal; and

9 receiving signals from communications devices in the plurality of cells or
10 sectors;

11 forming a multiplexed signal comprising the signals received in the cells or
12 sectors;

13 transmitting the multiplexed signal to a demultiplexer;

14 demultiplexing the received signals using the demultiplexer; and

15 providing the or each receiver with a received signal from each said cell or
16 sector; and

17 wherein said distributing and said transmitting use separate fibres of a single
18 fibre optic cable.

1 34. A method of distributing an rf transmitter signal to cells or sectors of a wireless
2 communications network, the method comprising:

3 converting the rf transmitter signal to an optical signal;

4 distributing the optical signal to the cells or sectors of the network over a fibre
5 optical cable; and

6 converting the optical signal to an rf signal for transmission at each said cell or
7 sector.

1 35. A multiplexer for multiplexing rf output signals from a plurality of transmitters
2 onto a multiplexed output signal, each transmitter serving at least one cell or sector in a
3 cellular communication network, the multiplexer comprising:

4 a plurality of rf-to-optical converters to convert the rf outputs of the plurality of
5 transmitters to a corresponding plurality of optical signals; and

6 an optical multiplexer to multiplex the plurality of optical signals to provide a
7 multiplexed optical output signal from which a signal for serving a cell or sector is
8 selectable.

1 36. A multiplexer as claimed in claim 35, further comprising at least one rf signal
2 combiner for combining rf outputs from a plurality of transmitters serving substantially
3 the same geographical cell or sector, or overlapping cells or sectors, and wherein said rf-
4 to-optical converter is coupled to an output of the rf signal combiner, to convert the
5 combined rf outputs to an optical signal for said optical multiplexer, whereby a signal
6 for serving a cell or sector comprising signals from a plurality of transmitters serving
7 the cell or sector is selectable from the multiplexed optical signal.

1 37. A multiplexer as claimed in claim 36, further comprising a demultiplexer for
2 receiving a multiplexed optical signal and for demultiplexing an optical signal for at
3 least one said cell or sector from the received multiplexed signal.

1 38. A multiplexer as claimed in claim 37, further comprising an optical-to-rf
2 converter to receive and convert the demultiplexed optical signal to an rf signal; and an

3 rf splitter coupled to the optical-to-rf converter to provide the rf signal to two or more
4 receivers serving the said cell or sector.

1 39. A demultiplexer for receiving and demultiplexing a multiplexed optical signal,
2 the multiplexed signal comprising signals received from a plurality of cells or sectors of
3 a cellular communications network, the demultiplexer comprising:

4 an optical demultiplexer to demultiplex the multiplexed optical signal into a
5 plurality of separate optical signals, each corresponding to a signal received from a said
6 cell or sector; and

7 a plurality of optical-to-rf converters, each coupled to the optical demultiplexer,
8 for converting the plurality of optical signals to a corresponding plurality of rf signals
9 for output to a plurality of rf receivers serving the said plurality of cells or sectors.

1 40. A demultiplexer as claimed in claim 39, further comprising at least one signal
2 splitter having an input coupled to an output of a said optical-to-rf converter and a
3 plurality of outputs, to output a corresponding plurality of versions of an rf signal input
4 to the splitter for providing the rf output signal versions to a plurality of receivers
5 serving substantially the same cell or sector or overlapping cells or sectors.

1 41. A signal receiver for a cell or sector of a cellular communications network, the
2 signal receiver comprising:

3 an optical input, to receive a multiplexed optical signal;

4 an optical selector to select a part of the multiplexed optical signal comprising
5 an optical signal carrying information for an rf signal for the cell or sector; and

6 an optical-to-rf converter, having an input coupled to the optical selector and an
7 output for receiving and converting the selected part of the multiplexed signal into an rf
8 signal, and for outputting the rf signal for transmission by the cell or sector.

1 42. A signal transmitter for a cell or sector of a cellular communications network,
 2 the signal transmitter comprising:
 3 an rf input for inputting an rf signal received from a cell or sector antenna;
 4 an rf-to-optical converter, coupled to the rf input, for converting the rf input
 5 signal to an optical signal; and
 6 an optical multiplexer, coupled to the rf-to-optical converter, to multiplex to the
 7 optical signal into a multiplexed optical signal comprising optical signals provided from
 8 one or more other cells or sectors.

1 43. A signal receiver or transmitter as claimed in claim 41 or 42, further comprising
 2 an optical signal monitor having an optical input for monitoring an optical signal
 3 present at the signal receiver or transmitter; and
 4 a signal transmitter, coupled to the optical signal monitor, for transmitting a
 5 system management signal to indicate that a level of the monitored optical signal has
 6 dropped below a threshold value.

1 44. A system for coupling cell transceivers of a cellular mobile communications
 2 network to respective cell antennas, the system comprising:
 3 a plurality of said cell transceivers and cell antennas;
 4 a transceiver signal combiner/separator coupled to the plurality of transceivers
 5 and to a signal bearer to combine transceiver output signals from the transceivers for
 6 output onto the signal bearer and to separate combined transceiver input signals
 7 received from the bearer for input to the transceivers;
 8 a signal bearer coupled to the combiner/separator to carry the combined
 9 transceiver input and output signals between the transceivers and each cell; and
 10 a plurality of cell signal combiner/separators, each coupled to the signal bearer
 11 and to a said cell antenna, to combine a signal received at the cell antenna with other

12 signals on the signal bearer received at other cell antennas to provide said combined
13 transceiver input signals, and to separate a transmit signal for the cell antenna from said
14 combined transceiver output signals.

1 45. A system as claimed in claim 44, further comprising a digital interface device
2 interfaced with each said cell transceiver to provide a common physical interface to a
3 data network shared by transceivers of different cellular communications networks.

1 46. A system as claimed in claim 45, wherein the signal bearer is configured to
2 provide redundant signal paths between a transceiver and a said cell.

1 47. A system as claimed in claim 46, wherein said transceiver signal
2 combiner/splitter comprises an optical multiplexer/demultiplexer.

1 48. A system as claimed in claim 44, further comprising a signal combiner/splitter
2 having a first interface comprising a plurality of first signal lines and a second interface
3 comprising at least one second signal line, the plurality of first signal lines being
4 coupled to a subset of said transceivers and the second signal line being coupled to said
5 combiner/seperator; the combiner/splitter combining output signals from the subset of
6 transceivers on the first signal lines and providing a combined output signal on the
7 second signal line, and receiving an input signal on the second signal line and outputting
8 versions of the received input signal on the first signal lines for reception by the
9 transceivers.

1 49. A system as claimed in claim 44, wherein said signal bearer additionally carries
2 television signals.

1 50. A system as claimed in claim 44, for use with a GSM cellular communications
2 network.

1 51. A system as claimed in claim 44, for use with an IMT-2000 cellular
2 communications network.

1 52. A cellular communications sub-system comprising a plurality of transceivers
2 each serving a respective cell, each cell having a cell antenna;
3 characterised in that
4 the transceivers for a plurality of said cells are substantially co-located, and in
5 that the system further comprises:
6 transceiver interface means to combine rf interfaces of a plurality of the
7 transceivers into a combined signal interface;
8 transport means to transport signals between the combined signal interface and
9 two or more of said cells; and
10 coupling means to selectively couple signals between said transport means and
11 each said cell antenna.

1 53. A cellular communications sub-system as claimed in claim 52, wherein said
2 transport means comprises optical signal transport means.

1 54. A cellular communications sub-system as claimed in claim 53, wherein said
2 optical signal transport means is configured for transporting a supplementary high
3 bandwidth data service.

1 55. A cellular communications sub-system as claimed in claim 52, wherein said
2 transceiver interface means and said coupling means both include a bi-directional
3 interface for, respectively, said transceivers and said transport means.

1 56. A cellular communications sub-system as claimed in claim 55, wherein said
2 transceiver interface means and said coupling means each comprise a signal combiner
3 and a signal selector.

1 57. A signal distribution system for distributing signals for a wireless
2 communications network in which a geographical area covered by the network is
3 divided into cells, the system comprising:

7 a multiplexer having inputs coupled to the first and second wireless transmitters
8 to receive the first and second signal outputs from the transmitters and having an output,
9 to multiplex the received transmitter outputs onto a multiplexed output signal;

10 a signal transporter coupled to the multiplexer output to transport the
11 multiplexed signal to first and second cell sites; and

12 a first signal selector at the first cell, coupled to the signal transporter to select a
13 first signal from the multiplexed signal corresponding to the signal output from the first
14 transmitter, for serving the first cell.

1 58. A signal distribution system as claimed in claim 57, further comprising a second
2 signal selector at the second cell, coupled to the signal transporter to select a second
3 signal from the multiplexed signal corresponding to the signal output from the second
4 transmitter, for serving the second cell.

59. A signal distribution system as claimed in claim 58, further comprising first and second wireless antennas at the first and second cells; means coupled to the reception antennas and to the signal transporter to multiplex signals received from the first and second reception antennas onto the signal transporter; and a demultiplexer to demultiplex the first and second receiver signals and to provide the demultiplexed signals to third and fourth receivers serving the first and second cells.

1 60. A signal distribution system as claimed in claim 57, wherein said signal
2 transporter forms part of a signal transport network providing a domestic analogue
3 and/or digital data transport service.

1 61. A signal transmission system for transmitting signals between a plurality of
2 transmitters and/or receivers and a corresponding plurality of antennas, each antenna
3 serving a separate cell of a cellular communications system, the signal transmission
4 system comprising a fibre optic cable for coupling the transmitters and/or receivers and
5 corresponding antennas, characterised in that:

6 the fibre optic cable includes a loop; and in that

7 the system further comprises a monitor to monitor integrity of signal
8 transmission on the cable loop and a switch responsive to the monitor to reverse a
9 direction of signal transmission on the cable loop and/or to select an end of the cable
10 loop for reception of signals from a cell of the communication system in response to the
11 monitor signalling that the integrity of signal transmission is or has been adversely
12 affected.

1 62. A signal transmission system as claimed in claim 61, comprising a plurality of
2 said transmitters and a corresponding plurality of said receivers and wherein said fibre
3 optic cable comprises a first fibre for transmitting signals for said transmitters, and a
4 second fibre for transmitting signals for said receivers.

1 63. A signal transmission system as claimed in claim 62, wherein a said monitor is
2 located at a cell and the switch is located remotely from the monitor, the system further
3 comprising means for transmitting a monitoring signal from the monitor to the switch.

1 64. A signal distribution system for a GSM mobile communications network
2 comprising a digital communications network, at least one Base Station Controller
3 (BSC) and a plurality of Base Transceiver Stations (BTSs), each Base Transceiver
4 Station having a digital interface coupled to the Base Station Controller via the digital
5 communications network,

6 characterised in that:

7 the system further comprises a common digital interface device to the digital
8 communications network; and in that
9 each of the Base Transceiver Stations is coupled to the common interface device
10 to provide a shared digital connection for the Base Transceiver Stations to the Base
11 Station Controller.

1 65. A signal distribution system as claimed in claim 64, further comprising signal
2 transportation means for transporting signals to and from a said BTS or Node B to a cell
3 site antenna over a cable TV signal distribution network.

1 66. A signal distribution system for a IMT-2000 mobile communications network
2 comprising a digital communications network, at least one Radio Network Controller
3 (RNC) and a plurality of Node Bs, each Node B having a digital interface coupled to the
4 Radio Network Controller via the digital communications network,
5 characterised in that:

6 the system further comprises a common digital interface device to the digital
7 communications network; and in that
8 each of the Node Bs is coupled to the common interface device to provide a
9 shared digital connection for the Node Bs to the Radio Network Controller.

1 67. A signal distribution system as claimed in claim 66, further comprising signal
2 transportation means for transporting signals to and from a said BTS or Node B to a cell
3 site antenna over a cable TV signal distribution network.

1 68. A signal distribution system as claimed in claim 11, 18, 65 or 67 or a method as
2 claimed in claim 28 or 31, wherein cable TV signals are carried in a first fibre optical
3 transmission band and communications network signals are carried in a second fibre
4 optic transmission band, separate from the first band.